

NOTES ON THE GENUS *ZOSTERA* S. LAT. IN NEW SOUTH WALES

S. W. L. JACOBS AND A. WILLIAMS

(Accepted 19.6.1978)

ABSTRACT

Jacobs, S. W. L. and A. Williams (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia 2000) 1980. Notes on the genus *Zostera* s. lat. in New South Wales. *Telopea* 1 (6): 451-455.—*Zostera capricorni*, *Z. muelleri* and *Heterozostera tasmanica* occur on the New South Wales coast. Their distribution is outlined, also their morphological and anatomical distinguishing characters are discussed. Lectotypes are designated and relevant citations included.

INTRODUCTION

Recent ecological studies sponsored by universities and government departments have produced numerous, non-fertile, eelgrass (*Zostera* s. lat.) specimens for identification. The paucity and poor quality of herbarium collections has made it difficult to identify these specimens. Collections of fertile material (although frequently present for up to six months of the year) or of rhizomes, the anatomical characters of which may be important for identification, are often missing both from "grab" samples and from drift material. Because of these factors, it was necessary to examine the anatomical characters of the rhizome mentioned by den Hartog (1970) and to relate these to anatomical features of the stem and leaf. Once this relationship was established, it was possible to use stem and leaf anatomy as an aid in the identification of incomplete collections.

The paucity of herbarium collections in the past has meant incomplete distributional information for species of eelgrass in New South Wales. Prior to the present study there were no specimens from a 650 km stretch of coastline (covering some 2½ degrees of latitude) in northeastern Victoria and southeastern New South Wales, and no information as to which species occurred there. The study has made it possible to provide up-to-date information on the distribution of each species.

METHODS

Relevant specimens in the National Herbaria of New South Wales (NSW) and Victoria (MEL) were studied, followed by the collection of material at as many localities as possible along the area of coastline which had not been sampled previously. Material for anatomical examination (preserved in 70% ethanol) was collected only from fertile specimens. Voucher specimens for all material are lodged at NSW. Material for sectioning was embedded in paraffin wax and sectioned on a rotary microtome.

OBSERVATIONS AND TYPIFICATION

(A) Taxa present

From examination of complete fertile specimens it was apparent that the two most common species of eelgrass in New South Wales are *Zostera capricorni* Aschers. and *Z. muelleri* Irmisch ex Aschers. *Heterozostera tasmanica* (Martens ex Aschers.) den Hartog, was found in only one locality. Full descriptions of these species with associated keys, discussion and illustrations are given by den Hartog (1970).

(B) Distinguishing characters

(i) Leaf-tip:

One of the most useful characters, often seen in otherwise inadequate specimens, is the shape of the leaf-tip. The entire, truncate leaf-tip of *Z. capricorni* can be distinguished from the (deeply-) notched leaf-tips of *Z. muelleri* and *Heterozostera tasmanica*. Leaf-tip shape needs to be assessed as a population characteristic rather than on the basis of one or two individual leaf-tips, since events in the later stages of development of individual leaves of *Z. muelleri* and *H. tasmanica* may prevent the formation of a notch (Taylor, pers. comm.).

(ii) Vascular bundle distribution:

Z. muelleri (and other *Zostera* spp.) have one central bundle and two cortical vascular bundles in the rhizome internodes, while *H. tasmanica* has one central and four or more cortical bundles (den Hartog 1970). In *H. tasmanica* the cortical bundles tend to be grouped towards the two opposite sides of the rhizome rather than being spaced evenly. A similar criterion can be used in stems, even when only a short piece is available because in *Zostera* spp. the same number (2) of cortical bundles occurs in erect stems as in the rhizome, whereas in *H. tasmanica* the erect stems have more than two bundles (sometimes slightly fewer than in the attached rhizome).

(iii) Fibre bundle distribution:

The fibre bundles in *H. tasmanica* occur in both the inner and outer cortex of the rhizome, while in *Z. muelleri* and *Z. capricorni* they are restricted to the outer cortex.

No difference could be detected in the distribution of fibre bundles in several specimens of both *Z. muelleri* and *Z. capricorni* and in two specimens of the northern hemisphere species *Z. marina* L. This finding is contrary to the primary key-character employed by den Hartog (1970) who uses the distribution of fibre bundles in the rhizome as one difference between the subgenera *Zostera* (includes *Z. marina*) and *Zosterella* (includes *Z. muelleri* and *Z. capricorni*). This discrepancy should not affect the status of the subgenera which are still distinguished by the closed leaf sheath in subg. *Zostera* and the open sheath in subg. *Zosterella*.

The fibre bundles of the rhizome and stem as well as the "accessory" bundles in the leaf (*sensu* den Hartog 1970) are indistinguishable in their anatomy. Setchell (1933) indicates the similarity of these bundles in his description. It is likely that they both perform similar functions and possibly combine both the functions of vascular transport and mechanical support implied in the terminology. It is suggested that the term "fibre bundles" be used for the bundles in all three organs.

(iv) Schizogenous air spaces:

The schizogenous air spaces of the leaves in *H. tasmanica* are separated by single-layered (occasionally two-layered) longitudinal diaphragms (1-2 cells thick in transection). *Z. muelleri* and *Z. capricorni* usually have the air spaces separated laterally by multi-layered longitudinal diaphragms. Single- or two-layered diaphragms are found only in very depauperate specimens.

(v) Cell membranes:

Raison (pers. comm.) in a joint study yet to be prepared for publication, has found that the cell membranes from samples of *Z. capricorni* and *Z. muelleri* behave quite differently when examined for temperature-induced phase changes using

electron spin resonance. *Z. muelleri* membranes are characteristic of a chilling-resistant species, whereas the membranes of *Z. capricorni* are more characteristic of a tropical or sub-tropical species. Samples were taken from the overlap zone of the two species distributions. No information is available about *Heterozostera*.

(vi) Production of erect stems:

H. tasmanica normally produces both flowering and non-flowering erect stems each spring and both types remain on the plant till the following autumn. In more marginal habitats, however, erect stems may not be produced each year. *Z. muelleri* and *Z. capricorni* normally only produce flowering erect stems. In cases where substrate has been washed away exposing more of the short vertical stems of *Zostera* it may be possible to confuse the two genera by relying on this character.

The fruiting stems of *Z. muelleri* and the erect stems of *H. tasmanica* break off and drift, usually during autumn. After this occurs, it is virtually impossible to distinguish the two species from external morphological features.

(vii) Retinaeculum shape:

The retinaecula in *H. tasmanica* are linear-lanceolate, whereas those of *Z. muelleri* and *Z. capricorni* are obliquely ovate or triangular (den Hartog 1970).

(C) Distribution of taxa

Zostera capricorni occurs all along the New South Wales coast. It extends northwards into Queensland and southwards into Victoria, as far as Mallacoota (37° 33' S, 149° 45' E), being less abundant south of 35° S latitude. The only record from Kangaroo Island (South Australia) is almost certainly drift material. The species also occurs on the coast of Lord Howe Island. It is found below high tide level in estuaries and bays which are at least periodically open to the sea. Healthy specimens are normally found growing in mud or in a mixture of mud and sand, occasionally overlying a substrate of rocks or sand. Specimens from sandy areas and/or on banks frequently exposed for long periods are characteristically small and narrow-leaved.

Zostera muelleri occurs at least as far north as Sussex Inlet (35° 09' S, 150° 35' E) on the South Coast of New South Wales, and south and west into Victoria, Tasmania and South Australia. In New South Wales it is quite common in inlets and estuaries with restricted access to the sea and may occur in lagoons which are infrequently open to the sea. Although its habitat is otherwise similar to that of *Z. capricorni*, it is uncommon to find the two species growing together. In the single locality where this was observed, at Narooma, N.S.W., *Z. muelleri* was growing well and flowering alongside stunted and non-flowering *Z. capricorni*.

The only living occurrence of *Heterozostera tasmanica* in New South Wales is in Jervis Bay on the South Coast. It is found elsewhere along the southern coastline of Australia. It has not been recorded between Corner Inlet (38° 46' S, 146° 19' E) in Victoria and Jervis Bay (35° 03' S, 150° 44' E), despite sampling in this region during the present study. This apparently disjunct distribution is possibly explained by the tendency for this species to inhabit more exposed areas on sandier bottoms in its localities north-east along the coast from Melbourne than in its localities around Melbourne. Perhaps the only suitable locality between the two cited above would be in Twofold Bay (37° 05' S, 149° 54' E), where it may yet be found. The three records from the Sydney region (den Hartog 1970) are drift specimens; the specimen from Pittwater resembles the broader-leaved Tasmanian material.

(D) Type citations and lectotypifications

There has been some confusion over the citation of the type descriptions for these species and the designation of types and/or selection of lectotypes. The correct citations are given here with relevant notes and lectotypes are chosen for each of the three species.

Heterozostera tasmanica (Martens ex Aschers.) C. den Hartog, Sea-Grasses of the World, 116 (1970). BASIONYM: *Zostera tasmanica* Martens ex Aschers., Linnaea 35: 168 (1867).

LECTOTYPE (here designated): Port Phillip, Victoria, *F. Mueller* 1866 (MEL 2905). This is the only specimen in MEL collected prior to the description. It was seen by Ascherson. Ascherson's other duplicates were in Berlin and were apparently destroyed. This specimen has usually been regarded as the type.

Zostera capricorni Aschers., Sitzungsber. Ges. Naturf. Freunde Berlin 1876: 11 (1877?)*; also Verh. Bot. Vereins Prov. Brandenburg 18: 59 (1876) (1877?)*.

LECTOTYPE (here designated): Moreton Bay, *Naumann* 10.x.1875 (UC).

Because of the uncertainty as to which of these two references should be accepted as the correct citation for *Z. capricorni* Aschers., we have formally selected a lectotype, even though we have not seen the specimen. Naumann's specimen from Moreton Bay (10.x.1875) (UC) has usually been regarded as the type and is mentioned in both descriptions. It has been examined by den Hartog who treats it as the type (den Hartog 1970) without stating it as such formally.

Zostera muelleri Irmisch ex Aschers., Linnaea 35: 168 (1867).

LECTOTYPE (here designated): Australia felix, *F. Mueller* Nov. 1852 (MEL 3759).

(E) Relationships between *Zostera* and *Heterozostera*

Differences in normal growth behaviour and anatomy are the characters den Hartog used to separate *Heterozostera* from *Zostera* at the generic level.

We agree with den Hartog (1970) in regarding *Heterozostera* as morphologically more primitive than *Zostera* and would add that the leaf anatomy in *Heterozostera*, with its less complex longitudinal diaphragms, would also tend to support this.

In marginal conditions (e.g. some areas in Jervis Bay) *Heterozostera* may only spasmodically produce erect stems, instead of its normal annual production of both erect vegetative and floral stems. This approaches the growth behaviour of *Zostera*. It is tempting to hypothesize that such a modified growth pattern in *Heterozostera* is similar to the growth pattern that could be expected in the progenitors of *Zostera*.

We emphasize that our recognition here of the genus *Heterozostera* is consistent with current usage only and its taxonomic status may require further consideration.

* There is some doubt about the actual date of publication in both of these cases. There is evidence that the latter was probably published in 1877 but only circumstantial evidence about the former. They are cited here in the same order as by den Hartog.

REFERENCES

- Hartog, C. den, (1970)—The sea-grasses of the world. North Holland Publishing Co., Amsterdam.
- Setchell, W. A., (1933)—A preliminary survey of the species of *Zostera* L. Proc. Natl. Acad. Sci. Wash. 19: 810-817.

APPENDIX

Specimens examined in anatomical studies. All specimens are located in NSW.

Zostera marina: *Eculescu* NSW 66663; *Borza* NSW 66667.

Zostera capricorni: *Williams* 135; *Jacobs* 2429, 2444, 2452.

Zostera muelleri: *Jacobs* 2360, 2362, 2370, 2372, 2374, 2383, 2390, 2398, 2400, 2401, 2402, 2406, 2407, 2437, 2438.

Heterozostera tasmanica: *Jacobs* 2364, 2367, 2369, 2375, 2384, 2388, 2389, 2391, 2455; *May* NSW 122567, NSW 122571, NSW 122573; *Rodway* 9192; *State Fisheries* NSW 122568, NSW 122569, NSW 122570, NSW 122572, NSW 122574; *Thompson* NSW 44444; *Thorne* 26548.